following are descriptions of auroras noted on the 7th and 27th, respectively:

An aurora was observed throughout northern New England from 9 p. m., 7th, to 3 a. m., 8th. An aurora was seen in northern Vermont on the 20th.—*Bulletin of the New England Meteorological Society.*

Eastport, Me.: a faint auroral arch, extending from north-northeast to northwest and to altitude 30°, was observed at 8 p. m., 7th. The display became very brilliant at 9.30 p. m., and ended at 11.45 p. m. Waves or beams of light shot up towards the zenith every few seconds, producing a most brilliant display.

Northfield, Vt.: an aurora was observed from 8.23 p. m. to 9.25 p. m., 7th, extending from northeast to north-northwest. Streamers rose to altitude 15°, with a dark cloud, luminous in spots, underneath. Another aurora was observed, 8.25 p. m., 22d. It resembled the one mentioned above, and lasted twenty minutes.

Number Four, Lewis Co., N. Y.: a brilliant auroral display became visible soon after dark on the 7th. It consisted of an arch of dark color, the ends of which touched the horizon, and its centre rose to altitude 15°. Above this arch a second one formed; it was of a uniform width and of a fiery red color. A third one appeared above the other two, from which streamers shot constantly upward during the display. The aurora attained its maximum brilliancy about 8.40 p. m. At 9.30 p. m. the arches had nearly disappeared, and there was but a diffusion of light from northwest to northeast.—*Report of voluntary observer.*

Saint Vincent, Minn.: an auroral display was observed 10.10 p. m., 7th. It consisted of a diffused white light which rose to altitude 45° and extended from azimuth 125° to 250°. This arch disappeared at 11.40 p. m. and was succeeded by a low irregular arch of very bright light, having an altitude of 8° and extending from azimuth 160° to 210°. Another auroral arch was observed 10.40 p. m., 27th, the arch extending from azimuth 120° to 160° and to altitude 6°. The light increased steadily in brilliancy until it attained its maximum intensity at midnight, at which time the arch had risen to altitude 15° and covered 150° of the horizon.

Fort Buford, Dak.: a faint auroral display began 10.48 p. m. and ended 11.55 p. m., 7th. It consisted of an arch about 3° in width which rose to altitude 45° and extended over 90° of the horizon from northwest to northeast. No changes of any note occurred during the display, except that the arch at times became slightly brighter. Another aurora was observed 10.26 p. m., 27th. It consisted of a well-defined arch of straw color, extending from northwest to within a few degrees of east, and rose to altitude 30°. Its maximum intensity occurred at 12.17 a. m., 28th. The light had a motion from west to east. The display ended 3.15 a. m., 28th.

Moorhead, Minn.: a very brilliant, steady, white arch of light, with occasional streamers of a pale rosy color, was observed 11 p. m., 27th. The arch extended from about azimuth 100° to 260°, and rose to altitude 40°. The aurora remained visible until daybreak 28th.

Fort Sully, Dak.: an auroral light, of a pale yellow color, was observed 10.15 p. m., 27th. It extended from azimuth 158° to 202°, and rose to altitude 10°. The light remained of a uniform color and intensity during the remainder of this date. The display ended during the night.

Auroras were observed during the month as follows: 4th, Pekin, Ill. 7th, New Hartford, Conn.; Fort Buford, Dak.; Eastport, Kent's Hill, and Orono, Me.; Amherst, Blue Hill Observatory, Newburyport, and Royalston, Mass.; Port Huron, Mich.; Saint Vincent, Minn.; North Sutton, N. H.; Madison, N. J.; Constableville, Ithaca, Barnes' Corners, and Wedgwood, N. Y.; Collinwood, Lordstown, and Vienna, Ohio; Eagle's Mere, Le Roy, and Rimersburgh, Pa.; Northfield, Vt. 8th, Nashua, N. H.; Lyons, N. Y.; Dayton and Clarksville, Ohio. 9th, Dayton, New Alexandria, and Portsmouth, Ohio; Greenville, Pa. 10th, Logan, Ohio. 14th, Pekin, Ill.; Clarksville, Ohio. 20th. Kent's Hill, Me.; Saint Vincent, Minn. 22d, Northfield, Vt. 27th, Fort Sully, Carrington, Fort Buford, Garden City, Kimball, and Webster, Dak.; Mount Morris and Winnebago, Ill.; Manson, Iowa; Duluth, Moorhead, and Saint Vincent, Minn. 29th, Ames, Iowa. 30th, Pekin, Ill.; Wedgwood, N. Y.

### THUNDER-STORMS.

The more severe thunder-storms are described under "Local storms." Thunder-storms were reported in the greatest number of states and territories, twenty-eight, on the 12th; in nineteen on the 20th; in eighteen on the 19th; in sixteen on the 11th, 21st, and 24th; in from ten to fifteen, inclusive, on the 1st to 3d, 6th, 13th, 14th, 17th, 18th, 22d, 23d, 25th, 26th, 28th, and 29th; in from five to nine, inclusive, on the 9th, 10th, 15th, 16th, and 30th, and in less than five on the 4th, 5th, and 8th. There were no dates for which thunder-storms were not reported in one or more states or territories.

Thunder-storms were reported on the greatest number of dates, twenty-one, in Texas; on seventeen in Missouri; on fifteen in Kansas and Louisiana; on thirteen in Ohio; on twelve in Indian Territory and North Carolina; on eleven in Alabama and Nebraska; on from five to ten, inclusive, in Ark., Cal., Colo., Conn., Dak., Fla., Ga., Ill., Ind., Iowa, Ky., Me., Md., Mass., Mich., Minn., Miss., N. J., N. Mex., N. Y., Oregon, Pa., S. C., Tenn., Va., Wis.; on less than five in Ariz., Del., D. C., Mont., N. H., R. I., Utah, Vt., W. Va., Wyo. In Idaho, Nevada, and Washington Ter. no thunder-storms were reported.

## MISCELLANEOUS PHENOMENA.

### PRAIRIE FIRES.

Rapid City, Dak.: a prairie fire started at the northeastern limit of the city at 2.45 p. m. 2d, and swept six miles down the valley before it was extinguished. The high wind caused the fire to travel at a fearful rate. Several ranches in the track of the fire were completely demolished; one person was burned to death and several injured.

Yankton, Dak.: during the high wind on the 2d, smouldering prairie fires were fanned, and extended into the city, consuming several buildings near the boundary. Prairie fires also prevailed north of the city on the 1st, and to the north and east on the 2d and 3d.

Fort Buford, Dak.: prairie fires were observed on the south side of the Missouri River on the 19th. Prairie fires were also observed three miles east of this place 26th; the wind, which was high from the northwest at the time, caused the fires to sweep rapidly to a belt of cottonwood timber along the river, setting fire to the timber, consuming all the low brush, and injuring the larger trees. The fires are supposed to have caught from sparks of locomotives.

Fort Sully, Dak.: it is reported that very destructive prairie fires swept over the eastern portion of this (Sully county) on the 2d and 3d. The fires were pushed onward before a gale, which at times blew at the rate of sixty miles per hour, and progressed fifteen to thirty miles per hour. Many farmers have been rendered entirely destitute by the fires, having lost all seed, farming implements, houses, and live stock. A careful estimate places the loss of property of all kinds, in this county, at from $50,000 to $75,000.

Prairie fires were also reported as follows: Wolsey, Dak., 15th, 17th, 18th; Fort Sill, Ind. T., 1st to 6th, 27th; Fort

Maginnis, Mont., 21st to 25th; Fort Assinniboine, Mont., 25th to 29th; De Soto, Nebr., 1st, 2d, 8th.

FOREST FIRES.

Raleigh, N. C., 8th: large fires are raging in the pine forests for many miles along the Raleigh and Augusta, and Carolina Central Railways. Thousands of trees have been destroyed and many fences burned. The fires have been in progress since the 5th, and the high winds have fanned them into fury.—*The Richmond Dispatch, April* 8.

La Crosse, Wis.: the numerous brush fires which have prevailed on the bluffs during the last few days were extinguished by heavy rain on this date.

Forest fires were also reported as follows: Morganton, N. C., 7th to 11th; Cedar Springs, S. C., 12th, 17th; Belmont and Trial, S. C., 6th, 12th; Nunnelly, Tenn., dense smoke from forest fires, 3d, 4th; Weston, Wis., 21st.

HALOS.

Solar halos were most frequently reported in Illinois, where they were noted on seventeen days; in Ohio on sixteen; in California and Oregon on fifteen; in New York on fourteen; in Missouri and Washington on twelve; in Dakota and Michigan on eleven; in Ind., Iowa, Kans., Me., Mass., Minn., N. H., N. J., Pa., S. C., Tenn., Va., Wis. on from five to ten inclusive, and in Ariz., Ark., Colo., Conn., D. C., Fla., Ky., La., Miss., Mont., Nebr., Nev., N. C., R. I., Tex., and Utah on less than five days; in Ala., Ga., Idaho, Ind. T., Md., N. Mex., W. Va., and Wyoming no solar halos were reported. They were noted in the greatest number of states and territories, seventeen, on the 11th; in sixteen on the 22d and 30th; in fifteen on the 8th; in fourteen on the 9th and 16th; in thirteen on the 7th; in twelve on the 14th, 15th, and 23d; in eleven on the 6th and 29th; in from five to ten, inclusive, on the 1st, 2d, 4th, 12th, 17th to 19th, 21st, 24th to 27th; in less than five on the 3d, 5th, 10th, 13th, 20th. There were no days for which they were not reported in one or more states or territories.

Lunar halos were most frequently reported in Illinois, where they were noted on eleven dates; in California and Missouri on nine; in New York on seven; in Michigan, Minnesota, Ohio, Oregon, and Virginia on six, and in Ala., Ariz., Colo., Conn., Dak., D. C., Fla., Ga., Ind. T., Iowa, Kans., Ky., Me., Md., Mass., Nebr., Nev., N. J., N. Mex., N. C., Pa., R. I., S. C., Tenn., Tex., Wash., W. Va., Wis., Wyo., and Vt. on five or less dates; in Ark., Idaho, La., Miss., Mont., N. H., and Utah no lunar halos were reported. They were noted in the greatest number of states and territories, sixteen, on the 11th; in fifteen on the 9th; in thirteen on the 8th, 10th, and 14th; in from five to ten, inclusive, on the 5th, 7th, 12th, 16th, and 17th; in less than five on the 1st, 3d, 4th, 6th, 18th, 20th, 22d, 23d, and 27th. On the 2d, 19th, 21st, 24th to 26th, and 28th to 30th no lunar halos were reported.

METEORS.

The distribution of meteors, by dates, was as follows: 1st, Whipple Barracks, Ariz.; Olympia, Wash. 2d, Whipple Barracks, Ariz.; Denver, Col.; Egg Harbor City, N. J. 4th, Rolling Green, Minn. 6th, Wauseon, Ohio. 7th, Humphrey, N. Y. 16th, Nashua, N. H. 17th, Statesburgh, S. C. 18th, Villa City, Fla.; Vevay, Ind.; Williamstown, Mass.; Statesburgh, S. C. 19th, Vevay, Ind.; Wellington, Kans.; Amherst, Mass.; Riddleton, Tenn. 20th, Villa City, Fla.; Vevay, Ind., Williamstown, Mass.; Kalamazoo, Mich.; Cleburne, Tex. 21st, Vevay, Ind.; Wedgwood, N. Y. 22d, Egg Harbor City, N. J.; Nashville and Nunnelly, Tenn.; Mesquite, Tex. 23d, Keeler, Cal. 25th, Red Bluff, Cal. 26th, Golconda, Ill. 27th, Mellville, La.; Riddleton, Tenn. 28th, Beverly, N. J.; Statesburgh, S. C. 29th, Leicester, Mass. 30th, Newburyport, Mass.; Wauseon, Ohio.

The following are descriptions of the more notable meteoric displays reported:

Nashville, Tenn.: a very brilliant meteor was observed 11.15 p. m., 22d. It started from about 20° above the horizon in the northeast quadrant and moved rapidly to the zenith, where it apparently stopped for a second and then shot off across the sky in a southeasterly direction. The track of the meteor was marked by a stream of silvery light of dazzling brilliancy from the northeast side of which sparks of light were thrown off at intervals, indicating that the motion of the meteor was circular as well as forward, and that the sparks were thrown off by centrifugal force. At the time it seemed to stop in the zenith a very distinct corona of about 8° in diameter was noted.

Olympia, Wash.: a very brilliant meteor was observed 12.05 a. m., 1st, moving in a south by east direction.

Carrollton, Carroll Co., Ohio: during a severe hail storm which passed over the southern portion of this county on the 12th, an aerolite fell near the residence of Dr. Samuel Black in Monroe township.—*Report of voluntary observer.*

Mellville, East Carroll Co., La.: on the 27th, soon after sunset, a meteor of large size, a ball of pale blue flame, was observed moving in a nearly horizontal direction from northwest to southeast. It did not explode, but disappeared in the distance as a light passing beyond the visual line.—*Report of Mr. L. J. Dodge to the Louisiana State Weather Service.*

Red Bluff, Cal.: a very brilliant meteor was observed at 12.10 a. m., 25th. Its apparent size was about one-fourth that of the moon, and it was of a vivid green color. The meteor started from a point a little west of north and at about altitude 45°, and descended at an angle of about 75°. When it had traveled about 30° it burst into small fragments, changing from green to an intense white light at the moment of bursting. There was no visible trail left in its path, and no detonation was heard. The electric light, a large incandescent lamp, about a block away from the observer, was totally eclipsed by the meteoric light, and seemed like a candle in comparison to the blinding brilliancy that filled the whole sky. This intense light lasted about four seconds.

MIRAGE.

Mirage were reported as follows: Davenport, Dak., 9th; Webster, Dak., 3d to 5th, 12th, 20th, 21st, 24th, 25th, 27th, 29th, 30th; Hampton, Iowa; Traverse City, Mich., 10th; Rolling Green, Minn., 25th. San Diego, Cal.: a mirage was observed in the southwest from 5 p. m. to 6 p. m., 12th; houses, trees, and other objects seemed to be setting in a vast lake; everything appeared close and very distinct.

SAND STORMS.

Wolsey, Beadle Co., Dak.: a severe sand storm occurred on the 2d; the wind was very high during the day and drifted the sand three feet in places. A great deal of grain, lately sown, was uncovered by the wind.—*Report of voluntary observer.*

Yankton, Dak., 2d: the wind backed from southeast to north, increasing in force until it attained a maximum velocity of forty-eight miles per hour from the north at 5 p. m. The dust and sand in the air, raised by the wind, became so dense at 2 p. m. as to obscure the sky; at times the sun was entirely hidden from view by sand and dust, and it became so dark as to require artificial light. Sand storms were also reported as follows: Woonsocket, Dak., 1st, 2d, 3d; Pekin, Ill., 3d; Concordia, Kans., 2d, 26th; San Carlos, Ariz., 27th; Keeler, Cal., 18th.

DROUGHT.

Dubuque, Iowa, 1st: the ground is very dry; farmers cannot plant seed, and ploughing is difficult. 5th: the drought is causing much uneasiness among farmers, and the cisterns in the city are generally dry. The drought was broken by the heavy rain on the 12th.

La Crosse, Wis., 6th: the continuous dry weather has caused the water in the rivers to become very low, and logs are rafted with difficulty. Rain is much needed both for farmers and lumbermen. The stage of water in the Mississippi River was so low on the 18th that navigation was seriously impeded. Heavy rain occurred on the 23d, breaking the drought.

Motes, Winston Co., Ala., 30th: the ground is too dry to

germinate seed. The dead timber is so dry that fires in the woods are hard to control, and considerable damage is being done by them.—*Report of voluntary observer.*

Lead Hill, Boone Co., Ark., 30th: the weather is dry and crops in general are in need of rain.—*Report of voluntary observer.*

Tuscarora, Elko Co., Nev., 30th: the weather during the month has been exceedingly dry and windy. The grass on the range is beginning to show signs of drying up. The Owyhee River is dry, and there is no snow of any account on the mountains. A hard time on stock is feared.

Beowawe, Eureka Co., Nev., 30th: the Humboldt River is lower than it has ever been at this time of the year, and there is no snow on the mountains. Hundreds of acres of barley in this county are suffering from drought.—*Report of Nevada State Weather Service.*

### SUN SPOTS.

Haverford College Observatory, Pa. (observed by Mr. H. V. Gummere):

| Date, April, 1889. | Number of new | | Disappeared by solar rotation. | | Reappeared by solar rotation. | | Total number visible. | | Faculæ. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Groups. | Spots. | Groups. | Spots. | Groups. | Spots. | Groups. | Spots. | Groups. | Faculæ. | |
| 4, 9 a. m | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | Definition good. |
| 5, 11 a. m | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | Definition poor. |
| 8, 3 p. m | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | Definition poor. |
| 9, 11 a. m | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | Definition good. |
| 10, 11 a. m | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | Definition good. |
| 11, 11 a. m | 1 | 4 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 2 | Definition poor. |
| 13, 12 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | .... | .... | Definition good. Clouds prevented observation of faculæ. |
| 15, 11 a. m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Definition poor. |
| 23, 12 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | Definition poor. |
| 24, 10 a. m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | Definition good. |
| 30, 9 a. m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Definition poor. |

Mr. John W. James, Riley, McHenry Co., Ill.: one, 20,000 miles diameter, seen 1st; on sun's meridian 6th, 10th, much smaller, probably vanished before reaching west edge; none others seen. Mr. M. A. Veeder, Lyons, Wayne Co., N. Y.: 3d, a spot of considerable size was seen about two days removed from the sun's eastern limb. This spot continued until the 11th when it faded out as it was approaching the western limb. 11th, a group of small spots was seen near the eastern limb. This group was not discovered on the day preceding, nor was it seen on the 13th. 19th, a group of bright faculæ appeared by rotation. 27th, an extensive group of faculæ was seen near the eastern limb in the location of the spot that was seen as above described on the 3d. Mr. H. W. Gowey, North Lewisburgh, Champaign Co., Ohio: sun spots were observed on the 2d, 3d, 5th, 7th, 8th, 10th.

## VERIFICATIONS.

The percentages of the official forecasts of the Signal Service for April, 1889, were not completed in time to be published in this issue of the REVIEW.

*Percentages of local verifications of weather and temperature signals as reported by directors of the various State Weather Services for April, 1889.*

| States. | Weather. | Temperature. | States. | Weather. | Temperature. |
|---|---|---|---|---|---|
| Illinois | 86.4 | 86.2 | New York | 84.6 | 88.0 |
| Indiana | 83.4 | 86.8 | North Carolina | 79.3 | 74.6 |
| Kansas | 92.3 | 92.3 | Ohio | 77.0 | 84.0 |
| Michigan | 81.0 | 81.5 | Pennsylvania | 82.0 | 86.0 |
| Minnesota | 77.0 | 78.0 | South Carolina | 84.5 | 88.5 |
| Nebraska | 86.6 | 86.5 | Tennessee | 84.0 | 91.9 |
| New Jersey | 77.7 | 90.0 | | | |

NOTE.—In the table of percentages of official indications verified for February, 1889, published in the REVIEW for March, 1889, the percentage of verifications for Washington Territory should be 74.6.

## STATE WEATHER SERVICES.

[*Temperature in degrees Fahrenheit; precipitation, including melted snow, in inches and hundredths.*]

The following extracts are republished from reports for April, 1889, of the directors of the various state weather services:

### ALABAMA.

The average temperature for the month was 2.7 above the normal. The cold days were the 6th and 7th, and the maximum temperature occurred on the 11th and 12th. The cold days were accompanied by northwest winds that were so dry and blighting that tender plants in the gardens and fields suffered considerably. In some sections the cotton was so much damaged it was deemed best to replant.

The rainfall was 1.98 below the average, and the soil has become quite dry. Farmers complain very much about the dry condition of the atmosphere and the withering of the crops on account of the lack of rain.

SUMMARY.

*Temperature.*—Monthly mean, 68.2; highest monthly mean, 68.7, at Tuscaloosa; lowest monthly mean, 57.5, at Butler and Florence; maximum, 91, at Citronelle, 23d; minimum, 32, at Valley Head, 7th; range for state, 59; greatest local monthly range, 53, at Wiggins; least local monthly range, 33, at Columbiana and Troy.

*Precipitation.*—Average for the state, 3.52; greatest, 6.62, at Greensborough; least, 1.40, at Elkmont.

*Wind.*—Prevailing directions, northwest and west.—*P. H. Mell, Signal Corps, Auburn, director.*

### ARKANSAS.

SUMMARY.

*Temperature.*—Monthly mean, 64.4; highest monthly mean, 69.6, at Russellville; lowest monthly mean, 61.7, at Heber, Osceola, and Ozone; maximum, 90, at Jimtown, Ind. T., 5th, and at Lead Hill, 2d; minimum, 33, at Little Rock; range for state, 57; greatest local monthly range, 55, at Jimtown, Ind. T., and Texarkana; least local monthly range, 33, at Lonoke.

*Precipitation.*—Average for the state, 2.84; greatest, 6.54, at Alexander; least, 0.50, at Heber.—*Prof. John C. Branner, Little Rock, director; W. U. Simons, Sergeant, Signal Corps, assistant.*

### COLORADO.

SUMMARY.

*Temperature.*—Monthly mean, 45.2; highest monthly mean, 56.0, at Magnolia; lowest monthly mean, 20.4, at Dolly Varden Mine; maximum, 88.0, at Longmont, 22d; minimum, —15.0, at Hartsel, 19th; range for state, 103.0.

*Precipitation.*—Average for the state, 1.73; greatest, 4.61, at Paoli; least, 0.54, at Glenwood Springs.—*Prof. F. H. Loud, Colorado Springs, director; T. W. Sherwood, Sergeant, Signal Corps, assistant.*

### ILLINOIS.

SUMMARY.

*Temperature.*—Monthly mean, 52.9; maximum, 86, at McLeansborough, 18th; minimum, 22, at Aledo, 4th, and at Pontiac, 6th; mean of maximum, 78.2; mean of minimum, 27.7.

*Precipitation.*—Average for the state, 1.96.

*Wind.*—prevailing directions, northwest and northeast.—*John Craig, Sergeant, Signal Corps, Springfield, in charge.*

### INDIANA.

The month of April, 1889, was exceedingly dry; small amounts of rain fell everywhere only on a few days. The deficiency of the amount for the state is nearly 2.00; the greatest deficiency occurred in the southern portion, and the least in the northern. The amounts measured during April, 1889, were the smallest in that month during the past ten years or more. The rains during the passage of the low areas of the 1st and 2d, 11th, 12th, 19th, and 24th, were accompanied by thunder-storms and hail; the hail which fell on the 12th was of large size, and fell in great quantities at many stations. Snow fell only in the northern portion on the 1st, 4th, 5th, and 6th, in small quantities.

The temperature was nearly normal; slightly above in the central, and slightly below in the northern and southern portions. The highest temperature was noted in the southern portion, 11th, in the central portion 19th, and on the 12th in the northern portion. The lowest was noted nearly everywhere, 6th. The range was uniformly 54 in all portions of the state. The